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discussions respecting experience and knowledge. More than often it has been regarded as an abstract form of self-evident apprehension, whose chief, and perhaps sole, function is to mark the limits of reasoning. How it may have come into our experience has been humorously and seriously debated from Locke downward. It may not be an exact source of knowledge, but this negation does not exclude the peculiar significance attached to *experiencing* the relation in question. The two cases following indicate that there is some meaning to the 'principle' when found in conscious processes at an earlier time.

A bright child, Helen B., four years of age, whose development has been normal in all particulars, perplexed her mother and myself by adding to a conversation, in which she was taking no part and which had no apparent concern for her, these words: "Whatever is alike is the same. If you are good, you have to be good; if you are bad, you have to be bad. Whatever is alike is the same." Tactful questioning failed to bring out any evidence that the utterance was an echo from something the child may have heard. The meaning of the statement seemed to be clear to the child, though able to explain or expand it in no other way. She persisted in the assertion with considerable show of feeling, amounting almost to triumph.

Another and more recent instance is that of a boy in his sixteenth year. In a certain class the teacher was endeavoring to get another pupil to complete the sentence, "A dog is—," for purposes of illustration. After several examples and some hesitation on the part of the second pupil, the first jestingly ventured to supply 'a dog,' the sentence then reading: "A dog is a dog." The teacher accepted the suggestion as 'all right,' and showed how such statements could be made. The boy, however, was confused with astonishment upon learning that his suggestion had passed from jest to earnest, and required a rather long period of time to recover and adapt himself to this relation, which had apparently never occurred to him previously.

These rather opposite cases go to show that the 'principle' is not utterly void when it first arises in the conscious processes, however thor-

oughly one may claim it to have been operative in primitive mental activities.

EDWARD F. BUCHNER.

NEW YORK.

SCIENTIFIC LITERATURE.

A Popular Treatise on the Physiology of Plants for the Use of Gardeners, or for Students of Horticulture and Agriculture. By DR. PAUL SORAUER. Translated by F. E. WEISS. London and New York, Longmans, Green & Co. 1895.

One of the excellent features of this book is that there has been a consistent endeavor on the part of author and translator to make it a book clearly within the grasp of the persons for whom it is intended.

The author has succeeded in dealing with many of the problems of nutrition, diffusion, assimilation, etc., in a way that is not only attractive, but can be understood by one who has had little previous training in the study of plants.

After the introduction the author takes up first the structure of the root, and in connection with the structure discusses also the function of the root in the processes of absorption and conduction of nutrient materials. This is followed by a chapter on the nutrition of the root, dealing with the substances in the soil which act as plant food, the effect they have on the plant and the form in which they are taken up by the plant. Practical suggestions are made concerning the best treatment of the soil, the nutrition of pot plants, etc. The treatment of roots in transplanting, in repotting, is also considered.

The structure of the stem and leaf are treated in the same readable way in relation to the functions which they play in the general plant economy. The remaining chapters are devoted to plain directions for pruning, propagating, watering and the general nurture of the plant and seed, from the standpoint of the horticulturist and gardener, and this part of the book, at least to one who deals more with the principles of plant development than with horticultural practice, seems to be admirably done.

GEORGE F. ATKINSON.

Contributions to the Analysis of the Sensations.

By ERNST MACH. Translated by C. M. WILLIAMS. Chicago. 1897.

The English-reading public is not a little indebted to the Open Court Company for its rendering into English of some of the best foreign writers of our day. Mr. Williams's careful translation of Mach's 'Analysis of Sensations' is a particularly valuable contribution.

In turning again to a work that has been before the public some twelve years, it will be unnecessary to take up anew the discussion of the particular problems treated. The part played by movement, either actually performed or merely 'willed,' in our perception of space (p. 60, etc.), by the mechanism of attention with its background of continuous bodily processes in our sense of time (p. 111, etc.)—the parts played by these factors have come to be well recognized items in our psychological stock-in-trade. Mach's contributions to the subject remain historically interesting as early, clear and richly illustrated efforts to call attention to these elements in our concepts of space and time. His attempt to reconstruct the psychology of tone, if it has not met with any such general acceptance, presents, nevertheless, a method of treatment that no tone-psychology can afford to pass over without notice. Since the fundamental concepts involved go beyond the special field of audition and serve to illustrate an attitude toward the whole psychology of sensation, reference to them may be left for that connection.

The present review may thus confine itself to a discussion of the points of broader interest for which Mach stands. Such a task in connection with the work before us is rendered pleasant by the author's simplicity of style and limpid clearness of thought. It is rendered difficult, on the other hand, by the desultory plan of treatment that he has consciously adopted. For although we are assured in the original preface that the same problem has been kept in mind throughout, yet to justify such a statement one must consider the problem to be a very general one, indeed.

Mach paves the way to the more technical part of his discussion by sketching in a most skillful manner a view of science in general, of psychology as a particular science, of the problem of sensation as illuminated by these general considerations. It is this part of the discussion that

appears to the reviewer to be the central interest of the work. One feels, too, that it lay nearest the heart of the author. It seems, then, to demand rather close attention.

Having swept the decks of such 'meta-physical' concepts as 'things-in-themselves,' science starts with complexes of experience, partly permanent, partly changing (p. 2). Among the relatively permanent complexes are the 'self' and the various groups we call bodies. Their permanence is, however, only relative; the division between them not fixed. The changes to which they are subject furnish an instigation to that analysis by which they are disintegrated into 'elements' (p. 5). These elements, for economic purposes grouped together under single names, separated into not very definite wholes, are, in the end, all alike 'sensations' (pp. 10, 152). Thus 'the world consists only of our sensations' (p. 10).

Starting from this empirical 'monistic' standpoint, it is with the 'connections' of this small number of ultimate elements that science deals (p. 18). The fields of the various sciences are defined, not by the kinds of elements they consider, but by the kinds of connections they take into account. Thus, the ordinary division between mind and body and the separation of sciences dealing with each is, like any other distinction between particular sciences, purely a practical device. "That traditional gulf between the physical and psychical research, accordingly, exists only for the habitual stereotyped method of observation" (p. 14). "There is no rift between the psychical and the physical, no *within* and *without*, no *sensation* to which an outward, different *thing* corresponds. There is but *one kind of elements*, out of which the supposititious *within* and *without* is formed—elements that are themselves *within* and *without* according to the light in which, for the time being, they are viewed" (p. 151). The same elements, viewed as connected in those groups that we call physical bodies, are objects of study for physics; when one of these physical bodies is regarded as an organism their connection is studied by physiology; when considered as a chain of mental events they offer the subject-matter for psychology (p. 153). Thus, all science is primarily an attempt to reproduce facts in

thought. All that it seems to be more than a detailed account of facts arises from the necessity of performing its function in an economical, even though symbolical, way (p. 154).

The empirical, phenomenalistic standpoint above defined is, perhaps, as satisfactory a basis for scientific development as can at present be formulated. It would, of course, be hasty to regard it as a final formulation. That it contains inherent difficulties must have been as evident to the author as it is to the critic. For example, when it is said 'the world consists only of our sensations' one naturally wonders where the frequently mentioned 'connections' between sensations are to come in. Or, again (the historical stumbling block of 'monism'), what is this experiential, or phenomenal, or sensational character, which, if everything possess it in common, would seem to be as difficult to define as a scholastic 'summum genus'? Finally that 'self' which is a group of sensations, an object of experience, conveniently separated on the basis of certain peculiarities it may possess from other objects, is left in undefined relation to that subject or observer by whom and for whose 'economic' ends the separation is made. Again the historic difficulties surrounding the relation of the self as subject to the self as object!

Nevertheless, it is not probable that any other theory removes these difficulties, although many seem more profoundly conscious of their existence. Their clearness and practicability have made views similar to those of Mach, favorite among scientists (cf. Münsterberg, Karl Pearson, *et al.*). Doubtless more elaborate care expended on the foundation would be out of proportion to the strength of the present scientific superstructure that rests upon it.

From the consideration of these general question Mach turns to his special problem, the psychology of sensation. The ideal of his effort he holds to be the determination of the 'connection of the psychologically observable data with the corresponding physical (physiological) processes' (p. 29). The guiding thread of such a research must be 'the principle of the complete parallelism of the psychical and physical' (p. 30).

It is but a step further to assume as many

physico-chemical neural processes as there are distinguishable qualities of sensation (Pref. to Eng. ed.). Similar principles of research are largely admitted and follow naturally from the concepts of Bell and Müller. But the question remains open as to whether different qualities of sensation are to be related to numerically different structures, or whether likeness and difference of mental status are to be related to qualitative likeness and difference of physico-chemical processes taking place in nervous structures whose numerical distinctness, even if existent, is accidental. Mach declares himself for the latter hypothesis, and an illustration is furnished in his treatment of tone-sensations. If, in this field, we look, with Helmholtz, for a special end organ corresponding to each pitch, likeness and difference of tones mean the excitation of the same and of different end organs, a point of much consequence in the theory of harmony. If, on the other hand, we regard the quality of the process that takes place in an end organ as a factor in the result, we might assume with Mach that every end organ is the seat of two kinds of energies (say a 'Dull' and a 'Clear'), the various ratios in which the two are excited being the physiological determinant of the pitch (pp. 128, 143, etc.). Two notes may then be more or less alike, although dependent upon numerically distinct end organs, since each involves the same two specific 'energies,' only in different ratios. Mach is thus enabled to give a physiological basis to that theory of harmony which makes it depend upon the presence of common overtones. All tones are more or less alike; harmonious tones are more alike than others, because their common (physiological) overtones reinforce each other (p. 144, ff.).

The particular tone theory presented by Mach, although highly ingenious, and although it has won for itself some protagonists (*e. g.*, Wundt), becomes a little strained when we try to explain why two simple tones of different pitch are not identical with one tone of intermediate pitch (p. 129). Still the general principle of sense physiology, on which the theory rests, is of the greatest interest. Those who would object that progress in the physiology of the senses has been in the direction of differentiating numerically distinct structures corresponding to

qualitative differences of mental states, must square their antipathy to Mach's theory with the prevailing acquiescence in the view that regards intensity differences as adequately explained by relating them to differences in the energy of excitation of the same physiological structure. It is only a step further to explain differences of quality by relating them to differences in the *ratios* of the energies involved in the excitation, either of the same, or of similar structures. Either our psychology of intensity must be brought into line with the progress of qualitative differentiation or the field must be left open to such theories as that of Mach.

The reviewer agrees with the translator that the matter contained in Mach's little work is by no means so limited as the number of pages. He offers this as an excuse for having passed over many points in the discussion more lightly than their importance deserved.

EDGAR A. SINGER, JR.

UNIVERSITY OF PENNSYLVANIA,

August, 1897.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

OCTOBER 14, 1897.—Mr. Schwarz spoke of the remarkable collection of insects recently made by Mr. H. G. Hubbard in southern Arizona. This collection is the most extensive and valuable which has been made in that part of the country. In Coleoptera alone it contains between 300 and 500 species new to the fauna of the United States. He exhibited a specimen of the myrmecophilous Scarabæid *Lissomelas fohri* Bates, a genus new to the United States and allied to *Cremastochilus*. The specimens collected by Mr. Hubbard were not found in ants nests, nor could any traces be found of thoracic glands which are supposed to be attractive to ants. The insect fauna of Arizona and southern California was discussed at some length by Messrs. Schwarz, Gill and Fernow. Mr. N. Banks exhibited specimens of *Chrysopa ypsilon*, each of which carried one or more minute Cecidomyiid flies on its wings. The specimens were collected by Mrs. Slosson in the White Mountains, and Mr. Banks considers that the Cecidomyiids use the Chrysopas as a means of locomotion. Mr. Ashmead mentioned a par-

asitic wingless fly of the family Borboridæ collected by Mr. O. F. Cook in Liberia, which uses a common snail for transportation purposes. Mr. Ashmead described a new genus of Cynipidæ from Liberia which he will call *Curriea*, after the collector, Mr. R. P. Currie. It is the only genus of the Cynipidæ with toothed hind femora, and bears a superficial resemblance to certain Chalcididæ. Mr. Howard read a short paper entitled 'Notes on the House-fly,' which gave rise to a discussion on the carrying of contagion by house-flies, in the course of which Mr. D. G. Fairchild described at some length a serious eye disease prevalent in the Fiji Islands, which is carried by the house-fly. Mr. N. Banks read a paper entitled 'A New Species of the Genus *Halarachne*,' the typical specimens of which had been taken from the bronchial passages of a seal which had died in the National Zoological Park. Mr. Ashmead read a paper entitled 'On the Genera of the Xyelinae.'

November 4, 1897.—Mr. Ashmead showed specimens of the male of *Pelecinus polyturator* from Indiana. The female of this species is very common, but the male is extremely rare. Mr. Ashmead thinks that this insect, the habits of which are not yet known, is probably parasitic upon some Coleopterous wood-borer, a conclusion which was discussed at some length by Messrs Schwarz and P. R. Uhler. Mr. O. F. Cook exhibited specimens of *Peripatus novaezealandica* and of two small species of *Peripatus* from the Bismarck Archipelago. Mr. Schwarz exhibited specimens of *Cychnus mexicanus* Bates, a species new to the fauna of the United States, captured by Mr. H. G. Hubbard, at Cave Creek, Arizona. Mr. Howard exhibited specimens of *Trypeta acidusa* Walker, reared from ripe peaches by Mr. A. Koebele, at Orizaba, Mexico, and spoke of the Mexican distribution of *Trypeta ludens*. The subject of the possible establishment of these fruit pests in the United States was discussed by Messrs. Howard and W. G. Johnson. Mr. O. Heidemann read a paper on 'Hemiptera found on the Ox-eye Daisy,' listing twenty-nine species and giving notes on their habits. Mr. O. F. Cook read a paper on 'New Dicellura,' an order which he has erected to include the allies of Japyx. He exhibited plates of ten species and showed specimens of a new